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CIA-RDP86-00513R000513720015-7

FRIDRICH, Josef

A high-frequency germanium mesa transistor. Sdel tech 12  
no. 5:162-167 My '64.

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CIA-RDP86-00513R000513720015-7"

41765  
S/194/62/000/008/033/100 ..  
D201/D308

9.11.60

AUTHORS: Hulík, Zdeněk, and Fridrich, Jan

TITLE: Insertion circuit for binary coding devices

PERIODICAL: Referativnyy zhurnal. Avtomatika i radioelektronika,  
no. 8, 1962, abstract 8-2-184 1 (Czech. pat., cl. 21 a3  
32/20; 21 a1, 7/01, no. 98854, Mar. 15, 1961).

TEXT: A circuit for connecting a binary code encoder device is patented. The device has two systems of input terminals. Each code digit is obtained by the change of potential across a given pair of input terminals, one for each system. The principle of insertion consists in that the number of terminals of the first system is equal to the number of shift digits while the number of terminals of the other system corresponds to the number of basic digits, i.e. of digits no one of which can be transformed into the other by cyclic transposition with any number of places. The description of the device and an example of its application are given. [Abstracter's note: Complete translation.] ✓

Card 1/1

FRIDRICH, Jaromir, inz..

Testing properties of portable electric ovens. Elektrotechnik 18  
no.4:100-102 Ap '63.

1. Elektro-Praga Hlinsko, vyzkumne stredisko Praha.

WILLIAMS, Jeremiah, 1944

Review life spans of atomic bomb survivors in Hiroshima  
PC no. 65172-173 do 1964

2. Reference Center of the International Commission on Radiobiology

Z/0039/64/025/006/0320/0327

ACCESSION NR: AP4039419

AUTHOR: Fridrich, J.

TITLE: Effect of drop of impurity concentration in base diffusion layer on mesa transistor parameters

SOURCE: Slaboproudny obzor, v. 25, no. 6, 1964, 320-327

TOPIC TAGS: transistor, mesa transistor, diffused base transistor, semiconductor, solid state physics, solid state circuitry, solid state diffusion, diffusion transistor, junction transistor, diffused p-n junction

ABSTRACT: The article discusses the effects of a drop in the concentration of impurities in the base diffusion layer upon the basic parameters of a mesa transistor. Citing data contained in literature, the author derives the physical relations for cutoff frequency, capacitance, breakdown voltage of the collector junction, base resistance and emitter efficiency. A drop in the impurity concentration creates an electric field which is characterized by the factor  $m$ . The transition period of the minority carriers through the base region  $n$  depends on the factor  $m$  only with low emitter current. The inner electric field fades with high

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ACCESSION NR: AP4039419

emitter currents. In this case, the period  $\tau_B$  does not depend upon the factor  $m$  and is the same for diffusion layer transistors as well as for those with homogeneous bases. The collector capacity and breakdown voltage of the collector junction depend upon the impurity concentration gradient at the junction point. Measurements of transistors with a base diffusion layer showed that, for a voltage of up to 10 volts, the diffusion is linear whose capacitance drops by the cube root of the collector voltage. The breakdown voltage of the diffusion grows by a power of the diffusion length and is proportional to  $80.45$ . These relationships were confirmed experimentally. The maximum of the Q factor is dependent upon the fixed thickness of the base. Original article has: 8 figures and 60 equations.

ASSOCIATION: Vyzkumny ustav pro sdelovaci techniku A. S. Popova, Prague (Research Institute for Communications Engineering)

SUBMITTED: 11Jan64

DATE ACQ: 19Jun64

ENCL: 00

SUB CODE: EC

NO REF Sov: 000

OTHER: 014

Card 2/2

FRIDRICH, Jaromir, inz.

Determination of the wire temperature in electric heating  
bodies. Elektrotechnik 19 no.1:12-13 Ja'64.

1. Vyzkumne stredisko n.p. Elektro-Praga, Hlinsko.

FRIDRICH, Rudolf

Czechoslovak experience with anticorrosion protection abroad.  
Ropa a uhlie 5 no.6:181 Je '63.

1. Chemoprojekt, Brno.

SOURCE CODE: UR/0054/66/000/003/0141/0143

ACC NR: AP7005008

AUTHOR: L'vov, O. I.; Fridrikh, V. L.

ORG: none

TITLE: On auto-ionization-type transitions involving excitons

SOURCE: Leningrad. Universitet. Vestnik. Seriya fiziki i khimii, no. 3, 1966, 141-143

TOPIC TAGS: exciton, electron transition, inelastic scattering

ABSTRACT: The following expression is derived for the cross section of inelastic scattering of electrons by excitons:

$$\sigma = \frac{2^{11} \pi^4 e^4 n_0 n_{ex} a_0^3}{e^2 (kT)^2 (a_0^2 + 4\lambda_0^2)^6} \left( \frac{m}{m_{ex}} \right)^{3/2} \frac{\exp \left[ - \frac{\hbar^2 q^2}{2m_{ex} T} \right]}{q}.$$

where  $n_0$  is the density of lattice points,  $n_{ex}$  the exciton concentration, and  $a_0^{-1}$  the effective Bohr radius of the s-like function  $\phi(0)$ . Also,  $\lambda_0 = \hbar^{-1}(2mE)^{1/2}$ ,  $E$  being the mean excitation energy of the exciton and  $q^{-1}$  the Debye screening radius. The expression

$$W = \frac{2^{11} e^4 n_0 n_{ex} a_0^3 \lambda_0^3}{3^3 e^2 k T (a_0^2 + 4\lambda_0^2)^6 m_{ex}}.$$

is obtained for the probability of an ionizing transition in the "collision" of two

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UDC: 548.0153

ACC NR: AP7005008

excitons. The rate constant of auto-ionization of excitons is  $\gamma \approx 1.5 \times 10^{-11} \text{ cm}^3 \text{ sec}^{-1}$ . Authors thank Prof. P. P. Pavinsky for his interest and attention to this work. Orig. art. has 6 formulas.

SUB CODE: 20/ SUBM DATE: 27Dec65/ ORIG REF: 063/ OTH REF: 008

Card

2/2

36967  
S/141/62/005/001/016/024  
E140/E435

9,7300

AUTHOR:

Fridrikh, Z.

TITLE: Quantitative criteria of quantification methods

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy.  
Radiofizika, v.5, no.1, 1962, 155-164

TEXT: The article is concerned with the quantitative evaluation of quantification (analogue-digital conversion) methods. For discrete signals, Shannon's measure  $H$  frequently termed the entropy is adequate but for a continuous signal capable of an infinite number of states the entropy is formally identically infinite. The author therefore proposes to apply Kolmogorov's  $\epsilon$ -entropy. In an infinite ensemble it is necessary to combine into one group all elements sufficiently close together in properties. If the distance at which the elements are combined into one group is  $\epsilon$ , and  $S_\epsilon$  is the minimum number of groups obtained after this process, then the relative  $\epsilon$ -entropy is equal to

$$H_\epsilon(D_X, D_T) = \log S_\epsilon \quad (2)$$

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E140/E435

Quantitative criteria ...

The absolute  $\epsilon$ -entropy is defined by

$$H_\epsilon(D_X, D_T)_a = \inf H_\epsilon(D_X, D_T) \quad (3)$$

where  $\inf$  is the lower bound of the relative  $\epsilon$ -entropy under all possible ways of forming the groups of magnitude  $\epsilon$ . The author goes on to indicate the application of this concept to the evaluation of the efficiency of quantification methods and to the efficiency of the digital representation of the signal. Various forms of analogue-digital conversion and various forms of digital representation are examined: quantification by level, with reading performed each time the signal intersects any of the quantification levels; the same, with reading performed only when a quantification level adjacent to the last one is intersected; an incremental method involving an approximating function due to the author. It appears that the last is the most efficient. In conclusion an appendix explains the calculation of the relative  $\epsilon$ -entropy by a graphical method.

There are 3 figures.

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Quantitative criteria ...

S/141/62/005/001/016/024  
E140/E435

ASSOCIATION: Moskovskiy energeticheskiy institut  
(Moscow Power Engineering Institute)

SUBMITTED: July 14, 1960 (initially)  
July 1, 1961, (after revision)

4

Card 3/3

FRIERIKH, Z.

Theory of discrete readings. Trudy MFA 52:31-46 '65.

Construction of a logical network for discrete transformations.  
Ibid. 52:47-54 (MFA 18:9)

L17282-63 EWT(1)/BDS/ES(s)-2 AFFTC/ASD/ESD-3/IJP(C)/SSD Pt-4  
ACCESSION NR: AP3004379 S/0109/63/008/008/1451/1461

AUTHOR: Serebrov, L. A.; Fridrikhov, S. A.

64  
62

TITLE: Kinetics of formation and critical potential of positive charge spot on  
a dielectric

SOURCE: Radiotekhnika i elektronika, v. 8, no. 8, 1963, 1451-1461

TOPIC TAGS: charge spot, dielectric, critical potential

ABSTRACT: The process of formation of a positive charge spot on an element of a dielectric target bombarded by a stationary beam of medium-energy electrons is considered. The process is subdivided into three stages: (1) full collecting of secondary electrons by the collector and an almost constant charging current; the charge-density distribution on the target follows that of the current density across the beam; (2) accumulation of surface charge and drastic fall of the charging current; (3) secondary-electron collection is practically halted. During

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L 17282-63  
ACCESSION NR: AP3004379

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the reduced collection of secondary electrons, a charge redistribution over the spot area takes place. The accumulated charge exceeds by approximately 50% the charge over the full-collection period. This fact permits determining the full charge of a storage element on the basis of structural data (thickness, permittivity, secondary-emission coefficient of the target, target-grid separation) and mode of operation (current and size of beam, collector-grid potential). Experimental verification was conducted under the following conditions: beam current, 1.5 microamp; primary-dielectric energy, 1 kev; secondary-emission coefficient, 2; collector-grid potential, 10-100 v; target-grid separation, 200 microns; square-pulse duration, 100 microsec; target was made from 20-micron mica single crystals. "We are using this opportunity to thank A. R. Shul'man for his constant attention and valuable advice, and also A. T. Starovoytov who performed some measurements." Orig. art. has: 9 figures and 6 formulas.

ASSOCIATION: none

SUBMITTED: 11Jul62

DATE ACQ: 20Aug63

ENCL: 00

SUR CODE: PH

NO REF Sov: 006

OTHER: 002

Cord 2/2

FRIDRIKHOV, S. A.

FD-3219

USSR/Physics - Electron Scattering

Card 1/1 Pub. 153-28/28

Authors : Shulman A. R. and Fridrikhov S. A.

Title : Inelastic electron scattering in single crystals of NaCl and KCl.

Periodical : Zhur. Tekh. Fiz., 25, No 7, 1344-1345, 1955

Abstract : The energy distribution of electrons emitted by NaCl and KCl under bombardment by an electron beam was measured and the results plotted in curves. A discrete spectrum of electrons emitted by the crystals under low energy bombardment electrons was revealed. Eight references, including one foreign.

Institution: --

Submitted : March 22, 1955

FRIDRIKHOV, S.A.

109-3-4/23

AUTHORS: Shul'man, A.R., Zakirova, I.R., Morozov, Yu.A. and  
Fridrikhov, S.A.

TITLE: The Problem of the Method of Investigation of Secondary  
Electron Emission of Non-metallic Substances (K voprosu  
o metode issledovaniya vtorichnoy elektronnoy emissii  
nemetallicheskikh veshchestv)

PERIODICAL: Radiotekhnika i Elektronika, 1958, Vol. III, No.3,  
pp. 329 - 338 (USSR).

ABSTRACT: Description of a method of the measurement of secondary  
electron emission is given. The method is characterised by  
the following features: reduction in the time necessary for  
the experiments, increased accuracy, good stability of the  
measuring system and the target and elimination of the ternary  
electrons. The main component of the experimental equipment  
used in the measurements is a spherical, glass bulb  
fitted with apertures for a target and an electron gun. Dia-  
meter of the sphere is 145 mm. The electron gun is of the  
standard type and is provided with a focusing electrode; it  
is also furnished with a reflecting diaphragm which eliminates  
the scattered electrons from the beam of the gun. The dia-  
phragm is given a potential near to that of the cathode. The dia-  
phragm is given a potential near to that of the cathode. The target is  
Cardl/4 gun is screened by means of a nickel cylinder. The target is

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## The Problem of the Method of Investigation of Secondary Electron Emission of Non-metallic Substances

the above mentioned electron gun, the collector and the anti-dynatron grid and contains the following units: supplies for the electron gun; a rotary potentiometer, supplies for the potentiometer, a synchronous motor; a registering instrument; a delay circuit, a rectangular pulse generator, an amplifier; a pulse lengthener; an oscilloscope with a triggered time base; an automatic switching device and a synchronous motor driving the tape of the registering device. The functioning of the equipment and its applicability to the measurement of the secondary electron emission was thoroughly investigated. It was found that the equipment could be used for single-pulse measurements as well as for the investigation by means of periodically repeated pulses; in particular, it was possible to obtain good reproducibility of the secondary emission coefficient. The effect of the anti-dynatron grid on the secondary emission current is illustrated by the curves of Figs. 5, 6, 7 and 8. From these, it is concluded that  $U_g$  should be of the order of 100 V. The stability of the primary electron current is an important factor in the equipment, especially when the de-celerating potential  $U_g$  is varied;

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The Problem of the Method of Investigation of Secondary Electron Emission of Non-metallic Substances

it was found that the primary current as a function of  $U_3$  did not vary more than 1 to 2%. Some measurements on the distribution of the secondary electron energies were carried out. The resulting curves are shown in Fig. 12. The Curve 1 of Fig.12 was taken for Ni at  $U_3 = -V_p$  (where  $V_p$  is the accelerating potential of the primary electrons); this curve is in good agreement with the results obtained by R. Warnecke (Ref.11), which are represented by Curve 2. There are 12 figures and 12 references, of which 6 are English, 5 Russian and 1 German.

SUBMITTED: February 18, 1957

AVAILABLE: Library of Congress  
Card 4/4

AUTHORS: Fridrikhov, S. A., Goryacheva, G. N. 48-22-5-2/22

TITLE: Secondary Electron Emission From Monocrystals of Alkaline-Haloid Compounds at Low Energies of the Primary Electrons  
(Vtorichnaya elektronnaya emissiya monokristallov shchelochnogaloidnykh soyedineniy pri malykh energiyakh pervichnykh elektronov) Data From the VIIIth All-Union Conference on Cathode Electronics, Leningrad, October 17-24, 1957 (Materialy VIII Vsesoyuznogo soveshchaniya po katodnoy elektronike, Leningrad, 17-24 oktyabrya 1957 g.)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya, 1958, Vol. 22, Nr 5, pp. 486 - 493 (USSR)

ABSTRACT: In the publications sufficient data on the interaction of slow electrons with the surface of solids are missing. The problem is neglected with respect to semiconductors and especially to dielectrics. A survey of publications (References 3-6) is given. To be able to judge with precision the physical meaning of the course of the curve  $\sigma = f(E_p)$  in case of low  $E_p$ , one must have data on the energy spectrum of the secondary electrons.

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Secondary Electron Emission From Monocrystals of Alkaline-Haloid Compounds at Low Energies of the Primary Electrons 48-22-5-2/22

These are absent in publications. The most reliable method of investigating the secondary electron emission of the dielectrics is the method of the single pulses (Reference 7); it has until now not been used for the last mentioned purpose. This deficiency will be compensated by this work. The device used for this purpose is described and illustrated (figure 1). Figure 2 shows the dependences  $\sigma = f(E_p)$ , which were obtained for artificially grown monocrystals in the variation range of from  $E_p$  3,5  $\rightarrow$  31 eV. The authors come to the following conclusions: 1) The mentioned pulse method reduced the phenomena which are connected with the charge of the surface and with the changes of the properties of the target in the bombardment to a minimum. 2) It has been proved that the true secondary electrons appear in a noticeable quantity in the spectrum if the energy of the primary electrons of the long wave limit of the first band corresponds with the proper absorption of the crystals. 3) From this value of the energy onward the emission coefficient of the slow electrons  $\delta$  increases rapidly. The domain of the steepest increase of  $\delta$  corresponds with the

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Secondary Electron Emission From Monocrystals of 48-22-5-2/22  
Alkaline-Haloid Compounds at Low Energies of the Primary Electrons

domain of the 1st and 2nd maximum of the proper absorption. 4) It has been demonstrated that the fine structure of the curves  $\sigma = f(E_p)$  of the alkaline-haloid monocrystals can be associated with the periodical field of the crystalline lattice. 5) It was found that a correspondence between the proper optic and electronic absorption of the alkaline-haloid crystals exists. This once again indicates that the electronic affinity of such crystals is very low. The theme of this work was suggested by A. R. Shul'man who advisedly assisted in the performance as well as in the discussion of the results. In the discussion of the abstract took part N. D. Morgulis, L. N. Dobretsov and the first author

(*Izvestiya Akademii Nauk SSSR Seriya Fizicheskaya*, 1958, Vol. 22, Nr 5, pp. 494 - 495). A discussion on the abstract of the authors was held together with a discussion of the abstracts by Gorodetskiy, D. A. and by Bronshteyn, I. M. apparently *Izvestiya Akademii Nauk SSSR Seriya Fizicheskaya*, 1956, Vol. 22, Nr 4). In this took part: K. B. Tolpygo,

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Secondary Electron Emission From Monocrystals of Alkaline-Haloid Compounds at Low Energies of the Primary Electrons 48-22-5-2/22

L. N. Dobretsov, N. D. Morgulis, I. M. Dykman, A. Ya. Vyatskin and A. R. Shul'man. There are 8 figures, 1 table and 19 references, 9 of which are Soviet.

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M. I. Kalinina (Leningrad Polytechnical Institute imeni M. I. Kalinina)

1. Secondary emitters--Properties
2. Secondary emission--Analysis
3. Single crystals--Applications
4. Dielectrics--Properties
5. Alkaline-haloid crystals--Applications

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AUTHORS: Zakirova, I. R., Fridrikhov, S. A. 48-22-5-9/22

TITLE: The Kinetics of the Charge Accumulation by the Surface of Dielectrics During Irradiation by an Electron Beam ( Kinetika nakopleniya zaryada poverkhnost'yu dielektrika pri obluchenii elektronnym puchkom ) Data From VIIIth All-Union Conference on Cathode Electronics, Leningrad, October 17-24, 1957 ( Materialy VIII Vsesoyuznogo soveshchaniya po katednoy elektro- nike, Leningrad, 17-24 oktyabrya 1957 g. )

PERIODICAL: Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya, 1958, Vol. 22, Nr 5, pp. 546 - 555 (USSR)

ABSTRACT: If charged particles strike the surface of a dielectric or an insulated metal body, these object become charged. The velocity of the charge accumulation and the quantity of the charge under equilibrium conditions depend on a number of factors which are determined by the properties of the surface that is to be charged and by the quantity of the impinging and the flying off particles. On the one side the charging of the dielectric surfaces can be undesired (e.g. in electrovacuum devices (Reference 1), on the other hand the operation of several electrovacuum devices (References 2,3) is based upon the uti-

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The Kinetics of the Charge Accumulation by the Surface 43-22-5-9/22  
of Dielectrics During Irradiation by an Electron Beam

lisation of the phenomenon of charging. Therefore the interest in the mechanism of formation and in the behavior of the charge spot on the surface of the dielectric. A survey of the publications dealing with the same subject is given. The authors applied a new pulse method for the investigation of the forming and disappearing kinetics of the charges on the surface of the dielectrics by a bombardment by electrons. It was found that from a certain instant (the moment of the disturbance of the condition of the full decrease of the secondary current) onward the velocity of the charge accumulation on the surface of the dielectric decreases. For this the influence of the fields is responsible, which are caused by the formation of the charge spot itself. This leads to the fact that in general case the surface of the dielectric obtains the quantity of electricity which would be sufficient for the charging of the target surface unto the collector potential neither during the occurring of the quasisteady state  $t_{qs}$  nor even less, within the period  $\tau$ .

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The latter cannot be reached at all because of an extremely slow charge accumulation after the reaching of the quasisteady state

The Kinetics of the Charge Accumulation by the Surface of Dielectrics During Irradiation by an Electron Beam 48-22-5-9/22

and because of a noticeable role which the leakages can play in this case. It was proved that the duration  $\tau$  during which the conditions of a full decrease of the secondary current are maintained linearly increases with the intensity of the collector field. Thus the quantity of electricity which was accumulated by the surface of the dielectric (at the movements  $\tau$  and  $t_{qs}$ ) depends at the concerned collector potential on the geometrics of the device. The so called barrier-net also serves for the increase of the period  $\tau$  i.e. for the ~~despouing~~ of the potential relief and for the acceleration of the process of charging unto the prescribed potential during the bombardment of the dielectric by means of an electron beam. The quantities  $\tau$  and  $t_{qs}$  are independent of the energies of the bombarding electrons. Under given concrete conditions they are determined by the quantity of the accumulated charge. This plot was suggested by A. R. Shul'man who assisted as an advisor. In the performance of the work V. V. Bashenko and T.A. Koryakina took part (measurements). In the discussion on the abstract V. Ya. Upatov, A. V. Morozov, L. N. Dobretsov, A. A. Mostovskiy and the first

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The Kinetics of the Charge Accumulation by the Surface of Dielectrics During Irradiation by an Electron Beam 48-22-5-9/22

author participated. There are 12 figures and 9 references, 7 of which are Soviet.

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M. I. Kalinina  
(Leningrad Polytechnical Institute imeni M. I. Kalinina )

1. Dielectrics--Electrical properties 2. Dielectrics--Surface properties 3. Electron beams--Applications

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FRIDRIKHov, S. A.

AUTHORS: Shul'man, A. R., Zakirova, I. R., Morozov, 57-1-13/30  
Yu. A., Fridrikhov, S. A.

TITLE: Secondary Electron Emission of Nickel (Vtorichnaya  
elektronnaya emissiya nikelya)

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1958, Vol. 28, Nr 1,  
pp. 87-96 (USSR)

ABSTRACT: The task of the present work was to close the gaps existing  
in literature regarding the energy spectra of secondary  
electrons emitted by metals, as well as to obtain data on the  
distribution of secondary electrons according to energies in  
nickel. That is to say of all those which are emitted within  
the whole range of secondary electron energy at various  $V_p$   
(energy of primary electrons) of from 200 to 2000 V with  
nickel. Starting from the data on the distribution of  
secondary electrons according to energies the problem of the  
importance of the quantities obtained at the investigation  
of the basic dependence (which characterizes the secondary  
emission characteristics of the material - of the dependence  
of the coefficients of the electron emission on  $V_p$ ) is dealt  
with. The method of spherical condenser with a spheric

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Secondary Electron Emission of Nickel

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suppressor grid was used. The method of the automatic recording of measuring results, as described in reference 2, was also used. As result of the investigation the following can be stated: 1) Tertiary electrons emitted from the collector exercise an essential influence on the measuring results of secondary current in the retarding field. The introduction of the suppressor grid offers the possibility to essentially decrease the influence of tertiary electrons and thereby to obtain much more reliable data than was earlier the case. The distribution of the secondary electrons according to the energies of from 0 to  $V_p$  was investigated. Complete lag curves for nickel were obtained at  $V_p$  of from 200 to 2000 V. 2) In the spectrum of the secondary electrons it is not possible to draw a limiting line between the reflected primary and the real secondary electrons. Apparently both kinds of electrons are represented in all parts of the spectrum. With small energies of secondary electrons assumption that real secondary electrons are of dominating importance is reasoned. For the analysis of the energy spectrum of electrons (of nickel) an assumed border between slow and quick secondary electrons, equal to

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## Secondary Electron Emission of Nickel

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100 eV, is chosen. 3) The basic fact resulting from the measurements is that in the spectrum of secondary electrons of metals the relative number of quick electrons can be compared with that of slow electrons. The width of the maximum corresponding to the slow real secondary electrons is a little greater than was earlier assumed. In order to mark the number of quick secondary electrons magnitudes are introduced as follows:  $\gamma$  - the part of quick electrons in secondary current and  $\eta$  - the ratio between the number of quick electrons and the quantity of the primary current.  $\gamma$  increases linearly with the increase of  $V$  and reaches up to 26% of the total number of secondary electrons at 1600.  $\eta$  is only little dependent on  $V$  and is equal to 33% of the primary current value at 1600. 4) The retardation curves in relative coordinates coincide with one-another only if  $V$  is greater than 1200 V. If  $V$  values are smaller the curves<sup>p</sup> differ. 5) With all values<sup>p</sup> applied for  $V$  an elastic reflexion of primary electrons takes place. The reflection coefficient at  $V > 800$  V is not greater than 5% of the total number of primary electrons. 6) When primary current is measured in the circuit of the target in the case of not complete

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Secondary Electron Emission of Nickel

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blanking of secondary electrons for the coefficient of secondary emission  $\sigma_T$  a value was obtained which differs from that of total retardation of secondary electrons. 7) In order to mark the emission of slow electrons the magnitudes  $\sigma_T$  and  $\beta$  can be used (coefficient of the emission of slow electrons). As the existing theories only take into account the stimulation of secondary electrons by primary electrons and as inelastic reflection of primary electrons and the formation of slow secondary electrons with the motion of quick secondary and of inelastically reflected primary electrons are not taken into account, the comparison between theoretical and experimental data can not be carried out with sufficient exactness. There are 12 figures and 8 references, 2 of which are Slavic.

ASSOCIATION: Leningrad Polytechnical Institute imeni M. I. Kalinin  
(Leningradskiy politekhnicheskiy institut imeni M. I. Kalinina)

Card 4/5

Secondary Electron Emission of Nickel

57-1-13/30

SUBMITTED: March 5, 1957

AVAILABLE: Library of Congress

Card 5/5

BAZHANOVA, N.P. [translator]; FRIDRIKHOV, S.A. [translator]; KAPITSA,  
M.L. [translator]; LEPESHINSKAYA, V.N. [translator]; SHUL'MAN,  
A.R., red.; POPOV, R.Yu., red.; KLIMENKO, S.V., tekhn.red.

[Characteristic energy losses of electrons in solids; collection  
of articles] Kharakteristicheskie poteri energii elektronov  
v tverdykh telakh; sbornik statei. Moskva, Izd-vo inostr.lit-ry.  
(MIRA 12:7)  
1959. 270 p.

1. Sotrudniki kafedry elektroniki Leningradskogo politekhnicheskogo  
instituta (for Bazanova, Fridrikhov, Kapitsa, Lepehinskaya).  
(Electrons)

7.31.20  
9 (3), 24 (3)

67312

AUTHORS:

Fridrikhov, S. A., Shul'man, A. R.

SOV/181-1-3-17/32

TITLE:

Investigation of Secondary Electron Emission of Some Dielectrics with Low Primary Electron EnergiesPERIODICAL: Fizika tverdogo tela, 1959, Vol 1, Nr 8, pp 1259 - 1267 (USSR)

ABSTRACT:

The present paper gives part of the results of the experiments carried out in the authors' laboratory on secondary electron emission of some dielectrics and semiconductors (mica, glass, alundum, fluorite, willemite, stibnite, etc) for low primary electron energies. Measurements were made by the pulse method, and an accuracy of 3 to 5% was attained when periodic pulses were used. The  $\sigma = f(V_p)$  curve ( $V_p$  denoting primary electron energy) has a clearly marked minimum with  $V_p = 60$  to 70 v. The first critical potentials of the substances investigated are summarized in a table. With low primary electron energies the  $\sigma(V_p)$  function depends on elastic and inelastic reflection of the primary electrons and on the emission of the true secondary electrons. From some definite  $V_p$  values in the range of low

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## Investigation of Secondary Electron Emission of Some Dielectrics With Low Primary Electron Energies

SOV/181-10-8-17/32

energies onwards the slowing-down curves have a slope which corresponds to a group of slow, obviously true secondary electrons. In metals elastically reflected electrons play the main part. If the electron energies are lower than  $V_p$ , then the electrons of the base zone cannot be excited. Therefore, these secondary electrons seem to be inelastically reflected primary electrons with an energy  $< V_p$ . The high values of the reflection coefficient  $R$  and of  $\sigma$  cannot be explained only by reflection of the primary electrons from the potential barrier on the surface of the substance. Electron - phonon collisions play the main part in slow primary electron reflection in the range of small  $V_p$ . This also explains the high  $R$  and  $\sigma$  values and the existence of electrons with energies  $< V_p$  in the electron spectrum. The  $\delta = \delta(V_p)$  curves and, thus, also the  $\sigma = f(V_p)$  curves for the various substances differ considerably from one another in the  $V_p$  range investigated.  $\delta$  is determined essentially by the primary electrons which are inelastically scattered by  $\psi$

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Dielectrics With Low Primary Electron Energies

phonons only at very low  $V_p$ . With a certain quantity  $V_p$  which is characteristic of every substance interactions between primary electrons and the electrons of the substance begin to play the main role. Some conclusions: The first critical potentials  $V_p^I$  do not depend on temperature. The coefficient  $R$  of elastic electron reflection is relatively great (0.6 to 0.7) in the range of very small  $V_p$  (2 to 3 v) for all dielectrics investigated, which is probably caused by quasielastic scattering of primary electrons from phonons. The  $R = R(V_p)$  curves differ only slightly from one another in the substances investigated. In this  $V_p$  range the  $\sigma$  values are relatively great and do not differ much for the various substances. With increasing  $V_p$ , however, secondary electron emission begins to differ considerably for various substances. The  $\sigma$  values for

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Dielectrics With Low Primary Electron Energies

average  $V_p$  are not unambiguously determined by the  $\sigma$  values  
with small  $V_p$ . There are 9 figures, 1 table, and 9 references,  
5 of which are Soviet.

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M. I. Kalinina  
(Leningrad Polytechnic Institute imeni M. I. Kalinin) ✓

SUBMITTED: August 5, 1958

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9.3120

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9-(3)  
AUTHORS: Fridrikhov, S. A., Shul'man, A. R. SOV/181-1-8-18/32TITLE: Investigation of Secondary Electron Emission of Alkali Halide Single Crystals With Low Primary Electron EnergiesPERIODICAL: Fizika tverdogo tela, 1959, Vol 1, Nr 8, pp 1268 - 1271 (USSR)

ABSTRACT: The authors report on part of the work carried out in their laboratory concerning secondary electron emission of dielectrics with low energies of the bombarding electrons. Measurements were carried out by pulse methods. The measuring device has been described already in an earlier paper. The beam of primary electrons came in perpendicularly to the plane (100). During the measurements pressure was  $2 \cdot 10^{-7}$  torr. The results of measurements made with various single crystals are illustrated in a diagram by curves  $\sigma = f(V_p)$ .  $\sigma$  denotes the secondary electron emission,  $V_p$  the counter potential applied to the collector. In the case of small  $V_p$   $\sigma$  actually does not increase monotonely, for the real function  $\sigma(V_p)$  has several breaks. For NaCl, e.g.,  $\sigma$  begins to increase considerably at  $\checkmark$

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50, 90, 140, 190, and 230 to 240 v. This "fine structure" is easily reproducible. Each of the alkali halide salts investigated (LiF, NaF, NaCl, KCl, KBr, KJ) has a proper "fine structure" of the curves.  $\sigma$  increases with decreasing width of the forbidden zone  $\Delta E_f$  of the crystals. With  $V_p = 240$  v,  $\sigma$  decreases about linearly with increasing forbidden zone width. The lower the ratio  $\Delta E_f/\chi$  (where  $\chi$  denotes electron affinity), the greater is  $\sigma$ . If  $V_p$  is of an order of several hundred v, then secondary electron emission usually is low in the case of substances with small forbidden zone width; for on their way to the surface, secondary electrons may lose much of their energy when interacting with the electrons of the ground band. In the single crystals of the alkali halide compounds investigated conditions for secondary electron emission are very favorable. In the experiments described all the conditions for the occurrence of secondary electrons are important: The observed  $\sigma$  values are determined by the energy which must be consumed for the transfer of the lattice electron from the  $\chi$

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forbidden zone into the vacuum. The relation observed between the variation of  $\sigma$  and the variation of  $\Delta E_f$  probably applies only up to such  $V_p$  at which the influence of secondary electron emission from the depth must no longer be neglected. Thus, the dependence of  $\sigma$  on the forbidden zone width is considerably more complicated than was assumed before and can hardly be represented in a general form. The periodic "fine structure" of the curves  $\sigma = f(V_p)$  and of their ascending branch requires further investigations. This type of "fine structure" is observed with  $V_p > 40-50$  v. The curves  $\sigma = f(V_p)$  may have two types of fine structure: 1) a fine structure connected with the band structure and 2) a periodic "fine structure" which has to be explained by further data. There are 3 figures and 11 references, 6 of which are Soviet.

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Investigation of Secondary Electron Emission of Alkali Halide Single Crystals With Low Primary Electron Energies SOV/181-31-8-18/32

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M. I. Kalinina  
(Leningrad Polytechnic Institute imeni M. I. Kalinin) 4

SUBMITTED: August 5, 1958

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S/194/61/000/012/065/097  
D201/D303

AUTHORS: Serebrov, L.-A., Fridrikhov, S. A. and Utkin, K. G.

TITLE: The character of the electric field in electron storage tubes with cylindrical and oval collectors

PERIODICAL: Referativnyy zhurnal, Avtomatika i radioelektronika, no. 12, 1961, 38-39, abstract 12G243 (Nauchno-tekhn. inform. byul. Leningr. politekhn. in-ta, 1960, no. 9, 108-113)

TEXT: The electrolytic tank simulator method was used to determine the magnitude and distribution of the electric field intensity in the dielectric target - correcting ring - collector space. The elliptical storage cathode ray tubes. Changing over from the cylindrical to the oval shape of the collector does not influence the field configuration to a great extent. In the absence of the correcting ring the target diameter is substantially uneven, the coefficient of inhomogeneity in the vicinity of e.g. 10% equipotential line

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The character of ...

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D201/D303

reaching the value of the order of 4. Introduction of the ring at the collector in the form of a conducting coating at the tube walls, makes it possible to straighten the field in the region of the 10% equipotential line only. At greater distances from the target the field remains substantially distorted. Straightening the field by increasing the collector-to-target distance is accompanied by a considerable weakening of the field intensity and is not, therefore, recommended. The experimentally obtained field maps for various shapes of electrodes are given. 3 references. Abstractor's note: Complete translation.

Card 2/2

**AUTHORS:** Vasil'yev, G.P., Politeva, N.M., Shabel'nikova, A.S., Porvova, L.Ia. and Yasnopol'skaya, A.A.

**TITLE:** Interdepartmental Seminar Cathode Electronics (The 11th Meeting) (Moshchduvedomstvennyj seminar po katodnoj elektronike) (11-e zasedaniye)

**PERIODICAL:** Radiotekhnika i elektronika, 1959, Vol 4, Nr 4, pp 731 - 732 (USSR)

**ABSTRACT:** A meeting of the seminar took place on December 1, 1958 at the Institut radiotekhniki i elektroniki AN SSSR (Institute of Radio-engineering and Electronics of the Ac.Sc.USSR). During the meeting 8 papers were read. Yu.G. Ptushinskij read a paper entitled: "Kinetics of the Adsorption of Oxygen on the Surface of Tungsten". The second paper, by I.M. Dybman and S.M. Pakar, dealt with "The Admixture Photo-effect of Semiconductors in the Region of the Exciton Light Absorption". The paper by T.L. Matikayevich was devoted to "The Problem of the Secondary Electron Emission of Thin Films of a Number of Organic Substances". The problem of "Surface Ionisation in a Strong Electric Field on a Surface with a Non-homogeneous Work Function" was considered by B.Ia. Zandberg and N.I. Ionov. I.N. Sakulina and N.I. Ionov read a paper entitled "Determination of the Electron Attachment Energy and of the Potentials of Atoms by the Method of Surface Ionisation". N.L. Yasnopol'skaya and A.P. Alekseyev dealt with the problem of "Passage of Steady-state Currents Through a Dielectric When the Current Carriers Are Introduced Through One of the Contacts by Means of Electron Bombardment". The lecture by D.A. Ganichev and K.G. Utkin discussed the following - "The Possibility of the Analysis of the Total-energy Distribution of Electrons in a Quasi-spherical Condenser". The work by M.I. Kapites, S.A. Fridrikhov, and A.R. Shul'man dealt with "An Investigation of the secondary electron emission and the characteristic energy losses of a number of dielectrics (glass, mica, fluorite and alkali-haloid monocrystals).

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Document ID: 600002

S/181/60/002/01/32/035  
B008/B014AUTHOR: Fridrikhov, S. A.TITLE: Secondary Electron Emission and Elastic Reflection of  
Slow Electrons From an NaCl Single CrystalPERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 1, pp. 171-173

TEXT: In the article under review, the author reports on a study of secondary electron emission by NaCl at low primary electron energy  $E_p$ . The results were obtained for a wide range of  $E_p$ -values by means of automatic recording of curves and in a higher vacuum than that described in Ref. 1. The author used spherical devices with a mobile target. Measurements were made by means of the pulse method and the automatic machine described in Ref. 2. The  $\sigma = f(E_p)$  curves and delay curves of the secondary current were recorded by means of an EPP-0.9 (EPP-0.9) potentiometer. Fig. 1 shows the  $\sigma = f(E_p)$  curve for NaCl single crystal for  $E_p$ -values between 0 and 25 ev. By means of the delay curves of the

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Secondary Electron Emission and Elastic Reflection of Slow Electrons From an NaCl Single Crystal S/181/60/002/01/32/035 B008/B014

secondary current it was possible to split up  $d = f(E_p)$  into two components:  $R = f_1(E_p)$  and  $\delta = f_2(E_p)$ .  $R$  - coefficient of elastic electron reflection,  $\delta$  - emission coefficient of slow (not elastically reflected and truly secondary) electrons. Fig. 1 shows  $R(E_p)$  and  $\delta(E_p)$ . The  $\delta = f(E_p)$  curve for the range  $0 \div 50$  ev is represented in Fig. 2. It shows a distinctly marked fine structure for NaCl crystal, which is identical with the one found in Ref. 1. The assumption that the threshold of the truly secondary electron emission of the NaCl single crystal has the nature of an exciton was also confirmed. The author thanks Professor A. R. Shul'man for his helpful advice, and the student V. P. Belevskiy for his assistance in this investigation. There are 2 figures and 4 references, 3 of which are Soviet.

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VB

Secondary Electron Emission and Elastic Reflection of Slow Electrons From an NaCl Single Crystal S/181/60/002/01/32/035  
B008/B014

ASSOCIATION: Leningradskiy politekhnicheskiy institut  
(Leningrad Polytechnic Institute)

SUBMITTED: July 29, 1959

Card 3/3

VB

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S/181/60/002/03/23/028  
B006/B017

24.7700

AUTHORS: Kapitsa, M. L., Fridrikhov, S. A., Shul'man, A. R.TITLE: Characteristic Energy Losses in the Reflection of Electrons  
From Single Crystals of Alkali Halide Compounds

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 3, pp. 517-523

TEXT: In a previous paper (Ref. 5) the two last-mentioned authors had already investigated inelastic electron reflection from alkali halide crystals, and they had found that the energy spectrum of secondary electrons (which are emitted by alkali halide single crystals) showed fine structure (Fig. 1 shows such a spectrum recorded on NaCl with a primary electron energy of  $V_p = 30$  ev). Such curves were also recorded on KCl, KBr, KI, and LiF. It was the aim of the present paper to conduct analogous investigations with higher accuracy and with small  $V_p$  in order to find the lower boundary of primary electron energy at which peaks of the characteristic losses can still be perceived in the secondary electron spectrum; furthermore, an attempt was made to separate the two possible

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Characteristic Energy Losses in the  
Reflection of Electrons From Single Crystals  
of Alkali Halide Compounds

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B006/B017

systems of maxima (the so-called right system of primary electrons and the left system of secondary electrons; the position of the maxima of the latter is independent of  $V_p$ ). The measuring technique is described in detail. The spectrum was measured automatically at a target temperature of 300 - 350°C, a primary current density of  $10^{-7} \text{ a/cm}^2$ , and a pressure of  $\sim 2 \cdot 10^{-7} \text{ torr}$ ;  $V_p$  was between 0.5 and 50 ev. Fig. 3 shows the spectra of the electrons reflected from NaCl single crystals at  $V_p = 30, 32$ , and 34 ev. The two systems of maxima can be clearly seen. Fig. 4 shows spectra of electrons reflected from NaCl at  $V_p = 5, 7, 9, 11$ , and 13 ev, and Fig. 5 depicts the spectrum at  $V_p = 21.5$  ev. Important loss peaks occurred only at  $V_p > 7$  ev. The peaks correspond to energy losses of about 1 - 1.2, 1.7 - 2, 2.6 - 2.8, 3.8 - 4.3, 5 - 5.4, 6 - 6.7, 7.5 - 8.1, 9 - 9.6, and 11 ev. The probability of higher energy losses rises with increasing  $V_p$ . The fine structure proved to be characteristic of the substance investigated. In conclusion, the results are discussed. Although the right system of maxima can be clearly attributed to the characteristic energy losses of electrons, the nature of the left system, however, needs further

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Characteristic Energy Losses in the  
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investigations. A relationship could be observed between the energy losses below 12 ev and optical data (cf. Table). Furthermore, it was established that the least primary electron energy at which characteristic energy losses still occurred (7 ev) was smaller than the width of the forbidden zone. There are 5 figures, 1 table, and 14 references: 4 Soviet, 6 US, 2 Japanese, 1 British, and 1 German.

ASSOCIATION: Leningradskiy politekhnicheskiy institut (Leningrad Polytechnic Institute)

SUBMITTED: June 6, 1959

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SEREBROV, L.A.; FRIDRIKHOV, S.A.

Appearance of a charge spot on the surface of a dielectric target  
bombarded by an electron beam. Radiotekh. i elektron. 5 no.10:  
1680-1686 O '60. (MIRA 13:10)  
(Electron beams) (Dielectrics)

FRIDRIKHOV, S. A., Cand Phys-Math Sci -- "Study of the interaction between low-energy electrons and dielectrics." Len, 1961 (Acad Sci USSR. Phys Tech Inst im A. F. Ioffe). (KL, 4-61, 185)

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B102/B104

Secondary electron emission...

the secondary electron energy distribution begins to display a maximum due to true secondary emission, and at which  $\delta$  begins to rise rapidly. Measurements were made in pulsed operation at  $t < 300^\circ\text{C}$  (BaO) and  $t < 500^\circ\text{C}$  ( $\text{Y}_2\text{O}_3$ ) with single pulses, and at  $t > \sim 300^\circ\text{C}$  (BaO) and  $t > \sim 500^\circ\text{C}$  ( $\text{Y}_2\text{O}_3$ ) with periodic pulses. BaO and  $\text{Y}_2\text{O}_3$  were deposited on a nickel and a tungsten backing, respectively, both ranging between 50 and  $100\mu$ . High-purity conditions were maintained throughout the work. Once the targets were completed, they were subjected to heat treatment for several hours. The measuring chamber was evacuated for 3 - 4 days with diffusion pumps until the residual gas pressure dropped to  $3 - 5 \cdot 10^{-9}$  mm Hg. The  $\sigma(E_p)$  curves of BaO layers displayed a low maximum at  $E_p = 3$  ev, a minimum at 5 ev, and, subsequently, a steep but not monotonic rise to 50 ev. The work function was found to be  $(1.6 \pm 0.1)$  ev.  $\delta(E_p)$  and  $R(E_p)$  were determined from the delay curves of the secondary current. As may be seen, the slow-electron spectrum begins at  $E_p = 5 - 6$  ev.  $\sigma$ ,  $R$ , and  $\delta$  as functions of  $E_p$  (Fig. 4) practically displayed no temperature dependence between 20 and

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Secondary electron emission...

350°C. Similar results were obtained for  $Y_2O_3$  layers. Regarding these,  $\sigma(E_p)$  was recorded for  $E_p$  being between 1 and 90 ev. The maximum was found at  $\approx 4$  ev, and the minimum at  $\approx 7.5$  ev, whereupon a nonuniform rise took place again. The work function was  $(3 \pm 0.1)$  ev.  $\sigma$  did not change between 20 and 1000°C. Here,  $E_p^*$  is 6.5 ev. For  $Y_2O_3$ , Fig. 8 shows  $\sigma$ ,  $R$ , and  $\delta$  as functions of  $E_p$ . In a detailed discussion, results are compared with those obtained for other dielectrics, and, above all, a qualitative agreement is found. A study of the energy spectra of elastically and inelastically reflected electrons yielded relatively high values ( $R_{\max} \approx 0.5$ ) for the reflection factors, compared with those relative to metals. They cannot be explained by the sole assumption of a quantum-mechanical reflection of primary electrons from the potential barrier of the vacuum-dielectric interface. It is necessary also to assume electron scattering within the lattice (e.g., also by phonons). The singularities shown by the curves (e.g.,  $\sigma(E_p)$  for BaO at  $E_p \approx 10, 15, 20$ , and 35 ev, for  $Y_2O_3$  at  $\approx 15, 25$ , and 35 ev; the singularities of curves  $R(E_p)$  and  $\delta(E_p)$  may

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Secondary electron emission...

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be seen in the figures) are associated with the energetic structure of the substances. Professor A. R. Shul'man, whose laboratory was used for the investigation, is thanked for advice and discussions. D. A. Gorodetskiy is mentioned. There are 8 figures, 1 table, and 28 references: 10 Soviet and 18 non-Soviet. The three most recent references to English-language publications read as follows: E. Taft et al. Phys. Rev. 113, 156, 1959; A. Lempicki. Proc. Phys. Soc. B66, 278, 1953; D. Wright, J. Woods. Proc. Phys. Soc. 66, 1073, 1953.

ASSOCIATION: Leningradskiy politekhnicheskiy institut imeni M. I. Kalinina  
(Leningrad Polytechnic Institute imeni M. I. Kalinin)

SUBMITTED: March 27, 1961

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9.3120 (1138)

20078  
S/181/61/003/009/010/039  
B102/B138

4

AUTHORS: Bazhanova, N. P., and Fridrikhov, S. A.

TITLE: A method of investigating secondary electron emission of dielectrics at low primary electron energies

PERIODICAL: Fizika tverdogo tela, v. 3, no. 9, 1961, 2620 - 2628

TEXT: The investigation of the interaction of slow electrons with the surface of solids is of considerable scientific and practical interest, but is met with considerable experimental difficulty. In order to avoid them, the authors developed a method for the automatic recording of the characteristics of secondary electron emission (s. e. e.) at low primary energies,  $E_p$ , (1 - 100 ev.). The determination of the  $E_p$ -dependence of the s. e. e. coefficient  $\sigma$  is based on the measurement of target potential  $V_H$ , contact potential difference  $V_{kp,n}$  and current in the target circuit  $i_M = i_1 - i_2$  for  $\sigma < 1$  (or  $i_M = i_2 - i_1$  for  $\sigma > 1$ ) at constant accelerating voltage  $V_p^0$  and constant primary current strength.  $i_1$  is the

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S/181/61/003/009/010/039  
B102/B158

A method of investigating secondary... primary current,  $i_2$  the secondary current. The following equation is derived:  $i_{H_2} = f(V_p^0 + V_{k.p.n.} - V_H) = f(E_p)$  which yields  $\sigma(E_p) = i_2/i_1 = 1 + f(E_p)/i_1$ ; ( $i_1 = \text{const}$ ). Fig. 1 shows a diagram of the automatic recording of this curve. The contact potential difference (between the electron-gun cathode and the target) is determined by a modification of the well-known method worked out by Anderson. Accuracy is about  $\pm 0.1$  v. Fig. 4 shows the design of the electron gun, Fig. 5 the arrangement of the apparatus as a whole. The electron gun was fitted with  $100-\mu$  tantalum electrodes. The energy spread of the primary electrons emitted from it did not exceed  $0.5 - 0.7$  ev. To check the operation of the arrangement, particularly that of the electron gun, a series of tests was carried out with automatic recording of the  $\sigma(E_p)$ -curves. These tests showed that with  $U_{a1} < 20$  v  $\sigma$  was independent of  $U_{a1}$  and the values received were in good agreement with published data ( $U_{a1}$  - potential at the focusing electrode of the gun). The distance between gun and target had practically no effect on the  $\sigma(E_p)$  curves between  $0 \leq E_p \leq 90$  ev. The automatically

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a method of investigating secondary...

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Recorded curves were excellently reproducible. The authors thank Professor A. R. Schul'man for his advice and interest. There are 8 figures and 15 references: 7 Soviet and 8 non-Soviet. The three most recent references to the English-language publications read as follows: H. Jacobs et al. Phys. Rev. 106, 1956; J. Jorson, K. McKay, Phys. Rev. 91, 1953; E. S. Sternglass, Phys. Rev. 95, 345, 1954.

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M. I. Kalinina  
(Polytechnical Institute of Leningrad)

SUBMITTED: March 27, 1961

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34150 (1140)

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S/109/62/007/003/019/029  
D234/D302

AUTHORS: Serebrov, L.A., and Fridrikhov, S.A.

TITLE: Electrostatic properties of an elementary storage unit for charges appearing on a dielectric target during secondary electronic emission

PERIODICAL: Radiotekhnika i elektronika, v. 7, no. 3, 1962,

TEXT: The authors consider a storage unit consisting of a circular zone of the target, for the two following cases: 1) The surface density of free charge on the target is described by Gauss' curve; 2) The surface density is constant. Formulae derived in a previous paper by the authors are used and results of numerical computations of the potential are given for characteristic parameters of the storage tube, in the form of graphs. Influence of principal construction parameters of the target bloc is also illustrated by graphs. Experimental verification of the results is described and is stated to confirm them qualitatively. It is concluded that the dimensions of the elementary storage unit exceed the cross-section of

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Electrostatic properties of an ...

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D234/D302

the primary electron beam at least  $3/2$  to 2 times. The polarization of the target weakens the field strength. Charge induced on the collector situated at distances of the order of magnitude of effective radius of the charged element of the target affects the field considerably. The approximation of the elementary storage unit by a plane condenser is stated to be justifiable only when the effective radius is at least twice as large as the distance between the target and the plane collector. The authors express their gratitude to A.R. Shul'man for interest and discussion. There are 8 figures, and 8 references: 6 Soviet-bloc and 2 non-Soviet-bloc.

SUBMITTED: July 7, 1961

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ACCESSION NR: AT4016308

S/0000/62/000/000/0263/0283

AUTHOR: Shul'man, A. R.; Fridrikhov, S. A.

TITLE: Interaction of electrons with alkali halide crystals

SOURCE: Vses. soveshch. po fiz. shchelochnogaloidn. kristallov. 2d, Riga, 1961. Trudy\*. Fiz. shchelochnogaloidn. kristallov (Physics of alkali halide crystals). Riga, 1962, 263-283

TOPIC TAGS: alkali halide crystal, dielectric, dielectric surface, elastic electron reflection, crystallography, radiation defect, electron irradiation, crystal physical property

ABSTRACT: For the last seven years, systematic studies of the electron bombardment of alkali halide crystals have been conducted in the Electronics laboratory of the Leningradskiy politekhnicheskiy institut (Leningrad Politecnical Institute). They covered elastic reflection of slow electrons, nonelastic electron reflection, characteristic electron energy losses, secondary electron emission, excited conductivity of NaCl-films, and the behavior of colored crystals. To reduce the charge accumulation on the dielectric surface and the changes in the target composition and structure, the bombardment was effected by an electron beam emitted in the form of a single rectangular 1-10  $\mu$  sec pulse. An EPP-09 electron

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ACCESSION NR: AT4016308

potentiometer was used for the 1 min. tape-recordings. A drawing in the article shows the assembly in detail. Most of the results of the studies were of an exploratory nature and may be partially summarized as follows: (1) dielectrics, in contrast to metals, have a relatively high coefficient of slow electron elastic reflection, reaching a maximum of 70-80% for primary electron energies of a few ev; (2) energy spectra of electrons reflected from alkali halide crystals show two different patterns; full and discrete; (3) the threshold of second electron emission is a definition which casts some light on the energy zonal structure of alkali halide crystals; (4) the coefficient of second electron emission of the crystals is high and depends mainly on the energy of primary electrons; (5) a beam of slow electrons is a very sensitive indicator of color centers in the subsurface layer; and (6) the lower the lattice energy the greater the electron absorption; hence, the lower the depth of color penetration in the crystals. The authors make extensive use of references in their discussion of the subject. Orig. art. has: 15 figures and 3 tables.

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M. I. Kalinina (Leningrad Polytechnical Institute)

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ACCESSION NR: AT4016308

SUBMITTED: 00

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DATE ACQ: 06Mar64

NO REF SOV: 023

ENCL: 00

OTHER: 016

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9.3/20

*100/00*  
S/109/62/007/009/017/018  
D409/D301

AUTHORS: Serebrov, L.A., and Fridrikhov, S.A.

TITLE: Field-enhanced secondary emission of thin NaCl-films

PERIODICAL: Radiotekhnika i elektronika, v. 7, no. 9, 1962,  
1649 - 1656

TEXT: A new method is proposed for studying the secondary emission of charged dielectric- and semiconductor targets. The applicability of the method is illustrated by the results of measurements conducted with thin NaCl-films on various bases (platinum, nickel, beryllium, graphite). The new method, developed by the authors, is a combination of the method of single pulses and of the two-beam method. This facilitates the experimental work, reduces to a minimum undesirable effects, and makes it possible to use television control of the homogeneity of charging of the target, as well as of the principal beam. The NaCl-films were about 0.5 microns thick; the beam current was about 1-2 microamp.; the pulse duration of the primary current was 3 microsec.; the residual-gas pressure in the vacuum apparatus did not exceed  $(1-5) \cdot 10^{-7}$  mm Hg. A diagram shows

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Field-enhanced secondary emission ...

S/109/62/007/009/017/018  
D409/D301

the dependence of the secondary-emission coefficient  $\sigma$  (of the NaCl film on a nickel base) on the time  $t$  of irradiation of the target by the auxiliary beam. A comparison of current-voltage curves showed that if the target is positively charged, then the primary current can be considerably amplified. The authors developed a pulse method and apparatus for measuring the secondary-emission current from dielectric- and semiconductor surfaces, for primary-electron energies ranging from 2 to 12 kev. The method provides for separation of the investigated effect from extraneous processes. A practically inertia-less effect of enhancing the secondary emission by the internal electric field was observed. With primary-electron energies of 3.5 - 9 kev, gain factors of up to 20 of the primary current, were recorded. It was found that the scattering properties of the base material have a considerable part in the field-enhanced secondary emission of NaCl-films, i.e., with other conditions being equal, larger gain-factors correspond to targets with a base, made of a metal with a larger coefficient of inelastic scattering. An analogous effect should be observed in the case of other emitters, similar to NaCl. It is evident that (in the cases under consideration), a particular value of the primary-current gain should not

Card 2/3

Field-enhanced secondary emission ...

S/109/62/007/009/017/018  
D409/D301

be ascribed to a given emitter, but to a system, one of whose elements is the charged dielectric- or semiconductor layer. There are 6 figures.

SUBMITTED: March 19, 1962

Card 3/3

ACCESSION NR: AP4011761

S/0181/64/006/001/0236/0246

AUTHORS: Fridrikhov, S. A.; Ivanov, V. N.; Serebrov, L. A.; Shevtsov, A. A.

TITLE: Secondary electron emission of positively charged dielectric films

SOURCE: Fizika tverdogo tela, v. 6, no. 1, 1964, 236-246

TOPIC TAGS: electron, electron emission, secondary electron emission, dielectric film, positively charged dielectric film

ABSTRACT: By using a technique combining single pulses and two beams, the authors have studied the effect of an internal electrical field with a strength of  $10^3$ - $10^6$  v/cm on the secondary emission of electrons from thin films (0.5-10 microns) of NaCl,  $MgF_2$ , glass, and mica in the energy range of primary electrons of 2-10 kev. They discovered an anomalous character of the dependence of emission coefficient amplified by the field on the energy of the primary electrons. For friable films of NaCl, the emission amplification proved to be much greater than for dense films of identical thickness. Increase in the energy of primary electrons was accompanied by a steady increase in the coefficient of emission.

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ACCESSION NR: AP4011761

Experimental curves proved to be in good agreement with the expression for coefficient of current amplification of nonindependent Townsend gas discharge. It has been established that the value of the emission coefficient depends essentially on the density of the dielectric film, that the most probable energy of secondary electron emission is about 10 ev, and that the energy spectrum of these electrons is Maxwellian. "The authors take this opportunity to express their thanks to A. R. Shul'man for his valuable counsel." Orig. art. has: 7 figures and 4 formulas.

ASSOCIATION: Politekhnicheskiy institut im. M. I. Kalinina, Leningrad (Polytechnical Institute)

SUBMITTED: 25Jul63

DATE ACQ: 14Feb64

ENCL: 00

SUB CODE: PH

NO REF Sov: 006

OTHER: 007

Card 2/2

ACCESSION NR: AP4034912

S/0181/64/006/005/1343/1355

AUTHORS: Fridrikhov, S. A.; Smirnov, P. V.; Serebrov, L. A.

TITLE: Some peculiarities of electron excited conductivity in dielectrics

SOURCE: Fizika tverdogo tela, v. 6, no. 5, 1964, 1343-1355

TOPIC TAGS: electron excited conductivity, dielectric, electron contact method, electric contact method

ABSTRACT: The specific features involved in two principal methods of experimental investigation of electron-excited conductivity in dielectrics were examined. It is shown that these features substantially affect the recorded values of excited currents. The electron-contact method does not permit direct observations, and the coefficient of excited conductivity must be determined indirectly, such as by recording the change in surface charge of the target. But measurements are dependent on secondary factors, such as field strength in the sample and the dark current (which cannot be measured independently of the excited current). The electrical-contact method is free from the inadequacies of the electron-contact method, but by this method the original current of electrons acting on the sample is unknown, and errors may result from this. In using the latter method, it is

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ACCESSION NR: AP4034912

advisable to measure the excited current of samples both during continuous electron bombardment and during single pulses with changing field polarity. Results of these measurements will permit the determination of the field strength of the internal space charge ( $\approx 10^5$  v/cm), the concentration of traps ( $\approx 10^{16}$  cm $^{-3}$ ), and the product of carrier mobility by carrier lifetime ( $\approx 10^{-8}$  cm $^2$ /v, for electrons). The values given are for a film of NaCl 10  $\mu$  thick, a potential difference up to 250 v, and an energy of primary electrons of 10 kev. Experimental volt-ampere characteristics of the excited current obtained during single pulses agree with the theoretical curve for photoconductivity current calculated by Hecht's formula. "The authors express their thanks to A. R. Shul'man for his constant interest and for his valuable advice." Orig. art. has: 7 figures and 12 formulas.

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. Kalinina (Leningrad Polytechnic Institute)

SUBMITTED: 14Nov63

SUB CODE: NP, EM

NO REF SOV: 012

ENCL: 00

OTHER: 005

Card 2/2

ACCESSION NR: AP4039657

S/0181/64/006/006/1702/1706

AUTHORS: Serebrov, L. A.; Fridrikhov, S. A.

TITLE: Some results of studies on strong fields of secondary electron emission  
of thin sodium chloride films

SOURCE: Fizika tverdogo tela, v. 6, no. 6, 1964, 1702-1706

TOPIC TAGS: electron emission, secondary emission, sodium chloride, primary  
electron energy, dielectric layer, mean free path, volt ampere characteristic,  
magnesium oxide, collector grid

ABSTRACT: The authors analyzed experimental data obtained in their own earlier  
works (Radiotekhn. i elektron. 7, 1649, 1962), by S. A. Fridrikhov, V. N. Ivanov,  
L. A. Serebrov, and A. A. Shevstov (FTT, 6, 236, 1964), and other data available  
in literature. They estimated the mean free path between collisions with the film  
surface and compiled the results on strong fields of secondary electron emission  
by thin films of NaCl. The thickness of film considered in these studies was on  
the order of  $0.5 - 0.6 \mu$ , the primary electron energy was on the order of 7-10 Kev,  
and the field at the dielectric layer was of the order of  $10^6$  v/cm. The tempera-  
tures behind the target were about 50, 100, or 200C. The time for complete

Card 1/2

EWT(1)/EWA(k)/EWT(m)/EPA(sp)-2/EPF(n)-2/EPA(w)-2/EWA/EWP(q)/T/  
EWP(b) - Pz-6/Pab-24/Pn-4 IJP(c)/ASD(a)-5/SSD/BSD/RAEM(a)/AFNL/ESD(gs)/  
ESD(c)/ESD(t)/RAEM(t) AT/JW/JD/JG  
ACCESSION NR: AP4044651

8/0048/84/028/008/1340/1345

110

105

AUTHOR: Butusov, M.M.; Ganichev, D.A.; Sominiskiy, O.G.; Fridrikhov, S.A.

TITLE: Increase in the emission of cathodes in crossed fields /Report, Third All-Union Conference on Semiconductor Compounds held in Kishinev 16-21 Sept 1963/

SOURCE: AN SSSR. Izv. Seriya fizicheskaya, v.28, no.8, 1964, 1340-1345

TOPIC TAGS: magnetron, secondary emission, oscillation

ABSTRACT: The authors investigated the pulsed behavior of a magnetron diode with a smooth cylindrical copper anode and a cathode system similar to that employed by R. L.Jepsen and M.W.Muller (J.Appl.Phys.22,1196,1951). The cathode system consisted of a hot tungsten helical "trigger cathode" and a cold cylindrical cathode from which secondary emission currents could arise. Findings of earlier investigators were confirmed. Abstracter's note: It is not entirely clear which, if any, of their results the authors consider new. The anode of the magnetron diode was approximately 1.8 cm in diameter, and the cathode was 0.7 cm in diameter and 2 cm long. The device was operated at anode potentials from 2 to 20 kV in magnetic fields up to 2.5 koe with 1 microsec pulses at a duty cycle of 1000. Various cathode materials were ex-

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ACCESSION NR: AP4044651

ployed, including Ni and activated CuBeAl. At sufficiently great anode potentials and magnetic fields, neither the cut-off curves (anode current versus magnetic field at constant anode potential) nor the curves of anode current versus anode potential at constant magnetic field were monotonic, but each had a large peak. The peak anode current  $I_m$ , the anode potential  $U_m$  at peak current, the magnetic field  $B$ , and the secondary emission coefficient  $d_m$  of the cathode material at peak current conditions were found to be related by  $I_m = A(d_m-1)U_mB$ . High-frequency "noise" with a discrete spectrum was observed in the range between 50 and 5000 megacycles/sec when the enhanced emission occurred. The behavior of these oscillations is not discussed, but it is suggested that they are the cause of the increased electron bombardment of the cathode which gives rise to the enhanced emission. The authors note that they have confirmed the existence of large secondary emission currents in crossed field instruments with no external resonators, and that these currents are associated with self-excited space charge oscillations. "In conclusion, the authors express their appreciation to Prof. A. R. Shul'man for his constant interest in the work and for valuable remarks." Orig. art. has: 1 formula and 9 figures.

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L 6813-65

ACCESSION NR: AP4044651

ASSOCIATION: Leningradskiy politekhnicheskiy institut (Leningrad Polytechnic Institute)

SUBMITTED: 00

SUB CODE: EC, NP

NR REF Sov: 006

ENCL: 00

OTHER: 004

3/3

ACCESSION NR: AP4013416

S/0057/64/034/002/0288/0296

AUTHOR: Butusov, M.M; Fridrikhov, S.A.

TITLE: On the anomalous violation of the Hull cut-off condition in strong crossed fields

SOURCE: Zhurnal tekhn. fiz., v.34, no.2, 1964, 288-296

TOPIC TAGS: magnetron, Hull cut-off, Hull cut-off violation, space charge oscillation, crossed fields, strong crossed fields

ABSTRACT: Cut-off curves (anode current vs. magnetic field) were obtained for a 2J32 magnetron and a specially constructed magnetron diode at anode potentials up to 20 kV. The tubes were operated with 1 microsec pulses at a duty cycle of 0.1%. The purpose of the work was to investigate the behavior of magnetrons in the region beyond the Hull cut-off at fields of the order of those commonly employed in practice. At low anode potentials the cut-off curves were smooth and monotonic, as has previously been reported by other authors. At higher anode potentials, however, the anode current began to increase at a magnetic field slightly above the "cut-off" value, reached a maximum, and subsequently decreased with further increase of the

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ACCESSION NR: AP4013416

field. The height and width of the peak increased rapidly with increasing anode potential. For the 2J32, the peak was perceptible at an anode potential of 5 kV. At 16.5 kV the peak current was about six times the zero field current and the full width of the peak at half maximum was about 600 Oe - roughly half the critical cut-off field. The peaks were not so high or wide for the magnetron diode, but they still were very conspicuous. In addition to the peaks, the cut-off curves showed considerable fine structure. The magnetron diode was provided with a cold cylindrical cathode and a directly heated tungsten cathode, the currents to which could be measured separately. The cold cathode was slotted, and the particles incident on the cathode and passing through the slot could be investigated with the aid of an auxiliary internal electrode. At low magnetic fields the entire anode current was carried by the hot tungsten cathode. As the magnetic field increased the cold cathode developed a small negative current (the electrode collected electrons) and bombarding electrons were observed to pass through the slot. At a magnetic field slightly above the critical cut-off value the cold cathode current changes sign and became large, and the number and energy of the bombarding electrons increased sharply. The anomalous current responsible for the peak was carried entirely by the cold cathode. When the magnetic field was further increased these trends reversed and

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ACCESSION NR: AP4013416

the cold cathode current again became negative. The behavior of the tube in the anomalous region varied with the secondary emission properties of the cathode material. An increase of the "excess noise" (due to space charge oscillations) was observed in the anomalous region. It is concluded that space charge oscillations lead to cathode bombardment by high energy electrons which, by secondary emission, give rise to the anomalous currents observed in the "cut-off" region. "In conclusion the authors express their gratitude to professor A.R.Shul'nykh for valuable advice and constant interest in the work, and to student V.V.Sologub, who participated in setting up the apparatus and conducting the experiments." Orig.art.has: 1 formula and 9 figures.

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M.N.Kalinina (Leningrad Polytechnic Institute)

SUBMITTED: 27Jan62

DATE ACQ: 26Feb64

ENCL: 00

SUB CODE: PH

NR REF Sov: 005

OTHER: 011

Card 3/3

FRIDRIKHOV, S.A.; SMIRNOV, P.V.; SEREBROV, L.A.

Some characteristics of the electron-induced conductivity of  
dielectrics. Fiz. tver. tela 6 no.5:1343-1355 My '64.

1. Leningradskiy politekhnicheskiy institut imeni Kalinina.  
(MIRA 17:9)

SERE BROV, L.A.; FRIDRIKHOV, S.A.

Some results of studying the field-amplified secondary electron emission from thin sodium chloride films. Fiz. tver. tela 6 no. 6:1702-1706 Je '64. (MIRA 17:9)

BUTUSOV, M.M.; GANICHEV, D.A.; SOMINSKIY, G.G.; FRIDRIKHOV, S.A.

Increased cathode emission in crossed fields. Izv. AN SSSR.  
Ser. fiz. 28 no.8:1340-1345 Ag '64 (MIRA 17:8)

1. Leningradskiy politekhnicheskiy institut.

L 14375-65 EWT(d)/EWT(1)/EWG(k)/EPA(sp)-2/EPF(n)-2/EPA(w)-2/T/EEC(b)-2/  
EWA/EWA(h) Pn-4/Pz-6/Pab-10/Fac-4/Peb/Pl-4/Pu-4/Pj-4 IJP(c)/BSD/  
ASD(a)-5/GSD/AFWL/RAEM(a)/ESD(c)/ESD(gs)/ESD(t) AT

ACCESSION NR: AP4045278

S/0057/64/034/009/1666/1676

AUTHOR: Sominskiy, G.G.; Terekhin, D.K.; Fridrikhov, S.A.TITLE: Current-voltage characteristic of a magnetron with a secondary emission cathode <sup>B</sup>SOURCE: Zhurnal tehnicheskoy fiziki, v.34, no.9, 1964, 1666-1676

TOPIC TAGS: magnetron, microwave oscillator, current voltage, characteristic, secondary electron resonance

ABSTRACT: The physical processes occurring in magnetrons are highly complicated owing to the fact that the electrons in these devices move in a system of fields consisting of a magnetic field, an electric field and a high-frequency field. In addition, one cannot ignore the interaction of the electrons with each other. The authors review the results of several experimental and theoretical studies of magnetrons. Then, on the basis of experimental data, they derive an empirical formula describing the current-voltage characteristic of a magnetron with a secondary emission cathode in the region of the peak of the characteristic curve. The initial step is to normalize the current-voltage characteristics by eliminating the parameter H (magnetic field intensity); to this end the curves are replotted in re-

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ACCESSION NR: AP4045278

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duced coordinates:  $(I_a/I_{a \max})$  versus  $(V_a/V_{a \max})$ , where  $I_a$  is the anode current and  $V_a$  is the corresponding voltage. The formula takes into account not only secondary emission, but also the geometry of the "interaction space". The deduced formula satisfactorily describes the ascending section near the maximum of the current-voltage characteristic of a magnetron. Finally, an explanation is given for some of the anomalies observed in the operation of magnetron type oscillators (enhanced emission, presence of high-energy electrons, etc.); this explanation is based on the theory of secondary electron resonance in the presence of a magnetic field. "In conclusion, the authors express their gratitude to Prof. A. R. Shul'man for his interest in the work and valuable advice." Orig.art.has: 19 formulas and 7 figures.

ASSOCIATION: Leningradskiy politekhnicheskiy institut im.M. I. Kalinina (Leningrad Polytechnical Institute)

SUBMITTED: 11Oct63

SUB CODE: EC

NO REF Sov: 007

ENCL: 00

OTHER: 006

Card 2/2

L 18844-63 EWT(1) SSD/BSD/RAEM(a)/AFWL/AFETR/ASD(a)-5/RAEM(c)/ESD(c)  
ESD(ga)/ESD(t)/IJP(c)

ACCESSION NR: AP4049056

S/0057/64/034/011/2086/2087

AUTHOR: Butusov, M.M.; Fridrikhov, S.A.

TITLE: Reply to the letter of S.Ya.Braude and I.M.Vigdorchik

B

SOURCE: Zhurnal tekhnicheskoy fiziki, v.34, no.11, 1964, 2086-2087

TOPIC TAGS: electric field, magnetic field, magnetron, history

ABSTRACT: The authors reply to the letter of S.Ya.Braude and I.M.Vigdorchik (ZhTF 34,2085,1964; see Abstract ACC.NR:AP4049055) pointing out that conclusions of their paper "On the anomalous violation of the Hull cut-off condition in strong crossed fields" (ZhTF 34,238,1964; see Abstract ACC.NR:AP4013416) concerning the existence of a sharp maximum in the cut-off curve of a magnetron diode at a magnetic field greater than the critical cut-off value and the phenomena at the cathode accompanying this effect have been known for more than 25 years and complaining that appropriate reference to the older literature were omitted. The authors deny any attempt to claim discovery of these long-known phenomena but assert that their investigation was more comprehensive than the previous ones and that some of their conclusions, particularly those concerning the role of space-charge oscillations,

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L 18844-65  
ACCESSION NR: AP4049056

are new. They apologize for not citing original sources and explain the omission of a bibliography by the fact that the phenomena are well-known and are now adequately discussed in the monograph and text-book literature.

ASSOCIATION: none

SUBMITTED: 20May64

ENCL: 00

SUB CODE: EM,EC

NR REF SOV:000

OTHER:000

2/2

L 23812-65 EWT(1)/EEC(b)-2/EWA(h) Peb

ACCESSION NR: AP5000841

8/0057/64/034/012/2160/2170

AUTHOR: Butusov, M.M. / Smirnov, N.S. / Sologub, V.V. / Fridrikhov, S.A.

TITLE: Investigation of the properties of the space charge in a magnetron diode

SOURCE: Zhurnal tekhnicheskoy fiziki, v.34, no.12, 1964, 2160-2170

TOPIC TAGS: magnetron, space charge, microwave tube, noise spectrum, secondary emission

ABSTRACT: The tendency to self-oscillation, characteristic of space charge in magnetrons, is well known; some of the oscillation effects, however, are associated (by some authors) with the influence of the resonator system. Hence in the present work there were investigated the properties of the space charge in a magnetron diode, i.e., a system devoid of a cavity component. There were studied the oscillations generated by the space charge under different conditions of operation of the tube, the relative secondary emission of the cathode, and the intensity (power) of back bombardment of the cathode. In some ways the present study was an extension of the earlier comprehensive work of J. Yasuoka (Proc.Phys.Soc.Japan 10,1102,1955), D. Glass, G.Sims & A.G.Stainsby (Proc.IEE(B) 102,81,1955) and R.L.Jepsen & M.W.Muller

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ACCESSION NR: AP5000841

(J.Appl.Phys.22,119G,1951).. Some of the experimental measurements were performed on the equipment described by two of the authors earlier (M.M.Butusov and S.A.Fridrikhov, ZhTF 34,288,1964). A diagram of the main measurement setup is given in a figure, as is a sectional view of the magnetron diode. The results are presented in the form of curves and some reproductions of oscillograms. The principal conclusions are: 1. At appreciable plate voltages there is a magnetic field region in which the electrons returned to the cathode have considerable energies, which gives rise to secondary emission. 2. In the same region there is observed intense emission by the space charge of high-frequency noise at discrete frequencies; analysis of this noise radiation indicates that part of the space charge oscillations are of the rotary wave type. 3. The fraction of the power dissipated at the cathode by the back-bombardment electrons, referred to the input power, increases with the strength of the magnetic field (at a constant plate voltage). 4. The mechanism leading to intense energy exchange in the electron cloud at the magnetron diode is probably similar in many respects to secondary-electron resonance in crossed fields. "In conclusion, the authors express their gratitude to Prof.A.R.Shul'man for his attention to the work." Orig.art.has: 9 figures.

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L 23812-65

ACCESSION NR: AP5000841

ASSOCIATION: Leningradskiy politekhnicheskiy institut im.M.I.Kalinina (Leningrad Polytechnical Institute)

SUBMITTED: 12Dec63

ENCL: 00

SUB CODE: EC

NR REF Sov: 010

OTHER: 012

3/3

L 51998-65 EPF(n)-2/EPA(w)-2/ENT(1)/ENG(e) PI-4/Po-4/Pz-6/Pab-10 IJP(e)

AT/NW

ACCESSION NR: AP5012045

UR/0057/65/035/005/0813/0822

AUTHOR: Ganichev, D.A.; Fridrikhov, S.A.; Ashkinadze, B.M.; Solgan, A.B.

53

52

TITLE: Investigation of a high frequency resonant discharge in crossed fields

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 35, no. 5, 1965, 813-822

TOPIC TAGS: secondary emission, resonant state, discharge plasma, microwave field, magnetic field, hydrogen

21

ABSTRACT: High frequency resonant discharge was investigated in the presence of a magnetic field because of the importance of the phenomenon for magnetrons and other high-frequency equipment and the paucity of such studies in the literature. The discharges were produced in a silver-plated oxygen-free copper rectangular waveguide section of dimensions 25.5 x 12.5 or 28.5 x 4 mm by 1  $\mu$ sec pulses of 3 cm wavelength  $H_{10}$  waves at a repetition rate of  $10^3$  sec $^{-1}$ . The applied magnetic field was perpendicular to the narrow wall of the waveguide, and in the wide wall were introduced two probes (with aquadag coated electrodes to minimize secondary emission) and a hot cathode. Hydrogen was admitted to the continuously pumped waveguide section. With the uhf oscillator operating at a controlled power level (up to 200

Card 1/3

L 51998-65

ACCESSION NR: AP5012045

kW/pulse) the magnetic field was gradually increased to 6000 Oe and the probe currents, the uhf attenuation, and the luminous intensity were observed. The shape of the individual light pulses was also observed with a wide-band amplifier and an oscilloscope. In addition to the uhf intensity (electric field strength) and the magnetic field strength, the residual hydrogen pressure was varied over a wide range. Many of the results are presented graphically and are discussed in some detail. At pressures from  $5 \times 10^{-6}$  to  $5 \times 10^{-2}$  mm Hg resonant discharges with ionization of the residual gas were observed at the two values of the magnetic field for which the electron Larmor frequency was equal to the uhf frequency or to half the uhf frequency. At pressures above  $10^{-2}$  mm Hg a third resonance was observed at a Larmor frequency one-fourth the uhf frequency. These resonant discharges occurred only for uhf electric field strengths exceeding a threshold value that depended on the gas pressure. The probe current increased rapidly with increasing pressure and reached a maximum at about  $3 \times 10^{-3}$  mm Hg. "In conclusion, the authors express their gratitude to A.R.Shul'man for his interest in the work and discussion of the results." Orig. art. has: 3 formulas and 11 figures.

Card 2/3

L 51998-65

ACCESSION NR: AP5012045

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M.I. Kalinina (Leningrad Polytechnical Institute)

SUBMITTED: 03Jul64

ENCL: 00

SUB CODE: EM, NP

NR REF Sov: 002

OTHER: 003

B3B

Card 3/3

L 15798-66 FBD/EWT(1)/EEC(k)-2/T/.../.../EWP(k)/EWP(b)/EWA(h)/EWT(m) SCTB/LJP(c) -  
ACC NR: AP6007095 SOURCE CODE: UR/0057/66/036/002/0394/0397

AUTHOR: Terekhin, D. K.; Fridrikhov, S. A.

ORG: Leningrad Polytechnic Institute im. M. I. Kalinin (Leningradskiy  
politekhnicheskiy institut)

TITLE: The effect of a longitudinal magnetic field on the operation of an  
He-Ne laser at  $\lambda = 0.6328 \mu$ .

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 36, no. 2, 1966, 394-397

TOPIC TAGS: laser, gas laser, helium, neon, longitudinal  
tube, photomultiplier

ABSTRACT: The effect of a longitudinal magnetic field on the operation of an  
He-Ne laser at  $\lambda = 0.6328 \mu$  was investigated experimentally. A discharge tube  
85 cm long and 4.4 mm in internal diameter, terminated with glass windows mounted  
at the Brewster angle, was filled to a pressure of 0.85 mm Hg with a neon-  
helium mixture at a ratio of 1:5.6. The discharge was excited at a fixed current  
values. The magnetic field, which was parallel to the laser axis, could be varied  
from 0 to 2000 oe. A semi-confocal resonator was used with dielectric-coated  
mirrors ( $R \approx 99.2\%$ ) placed at 120 cm. The laser power was measured in relative  
units by means of an FEU-22 photomultiplier. Curves of the laser power  $P_1$  as a  
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ACC NR: AP6007095

function of field intensity at various values of discharge current were plotted and analyzed. Three distinct regions could be observed: 1) a region in which a rapid initial increase in generation power occurred when the field intensity increased from 0 to 10-15 oe; 2) a region in which there was a subsequent, smoother increase in the signal, which may be preceded by a short sloping interval; and 3) (after a distinct power maximum at  $H \approx 150$  oe) a region in which a corresponding gradual decrease in laser output power occurred until the disruption of generation. The relative power increase in the first region was approximately equal for all values of discharge current and amounted to 150-200%. The rise in power in the second region was attributed to an increase in population inversion due to suppression by the magnetic field of generation at the  $3s_2 - 3p_1$  transition ( $\lambda = 3.39 \mu$ ). The smooth decrease in power in the third region was attributed to the separation of Doppler-broadened  $\sigma^+$ -components of radiation (both at  $1.15 \mu$  and  $3.39 \mu$ ) and to a decrease in the overlap region with an increase in  $H$ . The form of the function  $P_1 = P_1(H)$  changed when the parameters of the active medium varied sharply from the optimal. The longitudinal magnetic field  $H < 15$  oe re-established laser action at  $\lambda = 0.63 \mu$  when generation was disrupted because of an increase in the content of dopants in the discharge. Orig. art. has: 2 figures.

[YK]

SUB CODE: 20/ SUBM DATE: 03Jul65/ ORIG REF: 001/ OTH REF: 007/ ATD PRESS:  
Card 2/2 7795 4201

L 23267-66 FRD/ENT(1)/ENT(n)/EEC(k)-2/T/ENT(t)/ENT(k)/ENT(h) LTR(s) WD/JD  
ACC NR: AP6011406 SOURCE CODE: UR/0057/66/036/003/0560/0563

AUTHOR: Fotiadis, A. E.; Fridrikhov, S. A.

ORG: Leningrad Polytechnic Institute (Leningradskiy politekhnicheskiy institut)

TITLE: The effect of a longitudinal magnetic field on the output energy of an  
He-Ne laser at  $\lambda = 1.15 \mu$

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 36, no. 3, 1966, 560-563

TOPIC TAGS: gas laser, helium neon laser, laser output, magnetic field effect,  
longitudinal magnetic field

ABSTRACT: A detailed study was made of the effect of a magnetic field, parallel to  
the laser axis, on the output power of an infrared ( $1.15 \mu$ ) He-Ne laser at various  
gas-mixture pressures and pumping energies. The laser consisted of a semi-confocal  
resonator with external dielectric mirrors and a glass tube 100 cm long and 8 mm in  
diameter with Brewster-angle windows. The ratio of partial pressures inside the tube  
was 10:1 and the tube was placed inside and along the axis of a 70-cm-long solenoid  
in which fields from 0 to 1000 oe could be set up. Radiation was recorded by an  
FEU-22 photomultiplier placed at the output of an IKS-12 monochromator. The device  
could be excited by high-frequency a-c and/or d-c sources. Results indicate that at  
pressures of 1 mm Hg, a monotonic increase in output power at zero magnetic field  
occurs with an increase in the discharge current (from 15 to 70 ma, which corresponds

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ACC NR: AP6011406

to a variation in the pumping from 38 to 175 w). This also involves broadening of the H region, in which laser action is possible. In the  $0 < H < 15$  region an 8-15% increase in laser output occurs, which is followed by a maximum ( $15 < H < 115$ ) and a slow, Gaussian-like decrease ( $H > 115$ ). Similar results were obtained at other partial pressures and in the case of h-f excitation. This indicates that a change in the halfwidth  $\Delta H_{1/2}$  is directly related to changes in the characteristics of the Doppler circuit in the same manner as the laser output is at  $H = 0$ . The experimental results are in a good agreement with a theory advanced by M. I. D'yakonov (ZhETF, 49, 1173, 1965). Additional studies must be made before the ultimate explanation of the effect of magnetic fields on laser action at  $\lambda = 0.63$  and  $1.15 \mu$  can be made. Orig. art. has: 3 figures. [YK]

SUB CODE: 20/ SUBM DATE: 03Ju165/ ORIG REF: 002/ OTH REF: 006/ ATD PRESS:

4231

Card 2/2 *Jul*

ACC NR: AP7001315

4 mm Hg, and 10 to 22 kv for pressures from 6 to 12 mm Hg) shows, under pressures up to 4 mm Hg, monotonically rising curves to about 30 kv. In the higher pressure range, a narrowing of the emission zone occurs and the curves take the shape of sharp peaks which shift with pressure toward higher or lower values and tend generally toward higher output values at higher pressures. For a full explanation of these relationships further investigations are felt necessary. The observations of the cross-sectional intensity distribution within the output beam revealed an multimode structure. Under certain conditions (pressure 4 mm Hg, pumping voltage 14 kv) the beam cross section in the near zone took the form of a ring 12 mm in outside diameter and 5 mm in inside diameter. At higher pressures and higher pumping voltages, a delay and widening of the emission pulse as observed and explained earlier by Yegorov and others (Optika i spektroskopiya, 18, 1965, 719; ibid, 15, 1963, 839) took place. Attempts to obtain emission from the same tubes on the 6328 Å wavelength were unsuccessful at pressures of 1 to 8 mm Hg and pumping voltages of 6 to 30 kv. The authors thank A. R. Shul'man for his interest in the work and D. K. Terekhin and A. E. Fotiadi for useful discussions. Orig. art. has: 2 figures. [WA-14]

SUB CODE: 20/ SUBM DATE: 13Oct65/ ORIG REF: 004/ OTH REF: 005/

Card 2/2

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SOURCE CODE: UR/0057/66/036/012/2188/2190

AUTHOR: Perchanok, T. M.; Russov, V. M.; Fridrikhov, S. A.

ORG: Leningrad Polytechnic Institute im. M. I. Kalinin (Leningradskiy politekhnicheskiy institut)

TITLE: Some operational characteristics of the pulse emission of an He-Ne laser

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 36, no. 12, 1966, 2188-2190

TOPIC TAGS: ~~hence~~, laser pulse, ~~photo-laser~~, laser-pulse-emission, ~~He-Ne~~ laser, ~~He-Ne~~ pulse-emission, gas laser, discharge tube, phototube

**ABSTRACT:** The dependence of the output power of an He-Ne laser on its various parameters was experimentally investigated under conditions of short (0.5- $\mu$ sec) pulses in rapid (2000 pulses/sec) succession. A gas discharge tube with quartz windows installed at the Brewster angle in a semi-confocal resonator was used. An FEU-22 multiplication phototube served as the receiver. The output pulse shape of the 6-mm and 15-mm discharge tubes was recorded by an IO-4 oscilloscope. The dependence of output light pulses with a duration of 30—100  $\mu$ sec on the pumping power and pressure of the mixture was investigated. The optimal Ne and He ratios in the tube were 1 to 15 and 1 to 30 for 6- and 15-mm tubes, respectively. More powerful emission occurred from 15-mm tubes (about 1 wt), with pulse power about three orders higher than that under continuous emission. The average and peak output power of this tube, plotted against pumping voltage (varied from about 10 to 30 kv at pressures up to

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FRIDOLIN, G., inzh.; CHISTYAKOV, N.I., otv. za vypusk

[Operating cathode-ray oscilloscopes] Tekhnika raboty  
s elektronno-luchevymi osciloskopami. Moskva, Profizdat,  
1958. 14 p. (MIRA 13:12)

1. Nauchno-tekhnicheskoye obshchestvo priborostroitel'noy pro-  
myshlennosti.  
(Cathode ray oscilloscope)

Exhibit 60

9(1) PLATE I BOOK EXPLOITATION 307/289  
 USSR. Neaktivnyi elektronicheskiy administrativnyi resur  
 na poluprovodnikovye klyuchevye devyay. Sovet  
 stany. (Semiconductor Diodes and Triodes and Their Use;  
 Collection of Articles) Moscow, Tsvet, byuro tekhn. inform.  
 1958. 102 p. (Series: Detizhnyiye nauchn. i tekhnich.)  
 1,700 copies printed.

Consulting Engineer: Ye.Z. Kopytovskaya; Ed.: G.P. Omsa.  
 Purpose: This book may be useful to engineers in the field of  
 semiconductor electronics.

Content: The articles in this collection discuss problems in the  
 design, manufacture, and application of new types of semi-  
 conductor devices. The double-base diode is described and  
 results of the calculation of its characteristics are given.  
 Pass-transistor silicon and germanium triodes are discussed  
 and the characteristics of the type 314 fused-junction triode  
 are presented. The effect of feedback in transistor amplifiers  
 on nonlinear distortions is discussed. Operation of low-frequency  
 transistor amplifiers for individual units of multichannel  
 communication systems is explained and a discussion of  
 transistor units of the KP 30/60 system is presented. Attention  
 is given to the problems of cooling transistor devices. There  
 is a review of Soviet and Western magazines and patents for  
 applications. There are no references.

## TABLE OF CONTENTS:

Buravets, A.O. and G.M. Krichevich. Transistor amplifiers  
 for individual units of multichannel communication systems  
 61  
 The authors discuss the operation and characteristics  
 of a low-frequency transistor amplifier used in a  
 standard twelve-channel high-frequency system and derive  
 formulas for calculating amplifier performance. A  
 discussion of a transistor audio amplifier and a control-  
 signal receiver is also presented.

Sartsev, N.V. Cooling of Semiconductor Devices  
 The author describes a transistor chassis absorbing  
 heat from transistor circuits and derives expressions  
 that may be used in the design of transistor cooling  
 elements.

Prodelin, O.O. Review of Certificates of Invention,  
 Patents, and Patents for 1956 and 1957 Concerned With  
 Semiconductor Devices and Their Applications  
 I. Transistor Generators of Sinusoidal Oscillations  
 61  
 II. Flip-flop Circuits and Pulse Generators  
 61  
 The author reviews Soviet and Western patents and magazines  
 concerned with transistor circuits. He discusses the  
 operation of various transistor circuits. He discusses the  
 dividers, modulators, and multivibrators.

AVAILABLE: Library of Congress (37072-773 p-58)

FRIDOLIN, G. G.

9(1) NAME I. BOOK INFORMATION 507/1776  
 Moshchotekhnicheskoye obshchestvo pribranotekhnicheskoy proizvodstvennosti. Moshchotekhnika  
 Transistorov i aljotronov v pribranotekhnike: sbornik trudov konferentsii (Transistor Electronics in the Instrument-making Industry: Collection of Conference Transactions) Moscow, December, 1959. 269 p. 1,400 copies printed.

Mr. N.I. Chistyakov, Doctor of Technical Sciences, Professor;

Mr. of Publishing House: S.N. Khantseva, Tech Ed.: V.P. Sosulin; Managing Ed.: A.S. Zayrovskaya, Engineer.

PURPOSE: The book is intended for scientific and engineering personnel of the instrument-making and radio industries engaged in the development of electronic and radio equipment.

CONTENTS: The authors of this collection of articles discuss the theory, principle of operation, calculation and application of different circuits using transistors. They also describe transistor application in measuring circuits, computers, radio and automatic and remote control circuits. The book is based on transactions of the Scientific and Engineering Conference organized by MFO in Moscow in December 1956. The conference discussed 54 papers on thermistors, photocells, thermocouples, cooling elements, nonlinear capacitors, crystal diodes and transistors. A considerable number of these papers have been included in the present book. No references are mentioned. References appear at the end of each article.

## TABLE OF CONTENTS:

V.P. Kuchayev, Engineer. Thermal Stabilization of Pulse Circuits. 127  
 The author describes the operating principle of monostable multivibrators using transistor-type transistors and discusses the causes of instability. He also describes the effect of temperature on pulse width and describes temperature stabilization by means of diodes and thermistors. There are 3 references of which 2 are Soviet and 1 English.

Dr. Fridolin, Engineer. Transistor Oscillators and Their Application. 135  
 The author briefly describes the operation and application of the following transistor circuits:

oscillators with inductive capacitive feedback, tuned oscillators, tetrode transistor oscillators, frequency multipliers, phase-modulated oscillators, blocking oscillators, inverters, crystal-controlled oscillators, relaxation oscillators, oscillators converting sinusoidal signals into rectangular and triangular waves. There are 12 references of which 2 are Soviet, 7 English, 2 French and 1 German.